

1/14/02

To: Technology Council

From: Environmental Health Committee
Jim Woods, Chairman

Re: Research Needs Associated with High Profile Standards

Approach

In response to a request from the ASHRAE Board of Directors, the EHC investigated the environmental-health-related research needs associated with ASHRAE's high profile standards (62.1, 62.2, 90.1, 90.2, and 161). Requests for a list of research needs were directed to the chairperson of each SPC. Additionally, the EHC identified broad areas of research needs.

The chairpersons of Standards 90.1, 90.2, and 62.2 responded that there were no environmental-health-related research needs associated with their standards. The chairperson of SPC 62.1 returned a list of research needs, which is attached as Appendix 1. The chairperson of SPC 161P indicated that there are many needs for health and IAQ research associated with aircraft air quality, but that the SPC does not define research needs. Our general interpretation of these responses was that SPCs (other than SSPC 62.1) have not taken the time to define research needs and, consequently, that EHC needed to develop its own ideas about research needs associated with most of these high profile standards. The following text summarizes these research needs.

Standards 90.1 and 90.2

Standards 90.1 and 90.2 address building energy performance and do not directly address health or IAQ. However, there are many links between the energy and IAQ-performance of buildings because both are strongly affected by the design, construction, operation, and maintenance of buildings, as well as by the activities of occupants. Consequently, the EHC research subcommittee identified the following general areas of research needs related to these standards.

- **Causes of the association of air conditioning with increased SBS symptoms.** Many studies have documented that occupants of air-conditioned building have, on average, a higher prevalence of sick building syndrome (SBS) symptoms than occupants of naturally-ventilated buildings. These associations remain significant after controlling for known confounders. However, in some air conditioned buildings SBS symptom prevalences are quite low, implying that aspects of air conditioning design, construction, operation, or maintenance may increase risks of

SBS symptoms in a subset of air conditioned buildings. Since air conditioning is a major source of energy use addressed in ASHRAE standards, research is needed to elucidate the cause of the associations of air conditioning with symptoms and to evaluate preventative or remedial measures.

- **Impacts of uncontrolled airflows in buildings on IAQ, health, and energy use.**

Unintentional airflows occur in many buildings due to leakage in ducts and air handler cabinets and improper air distribution and space pressure control. Excessive leakage in building envelopes also contributes to these uncontrolled airflows. These uncontrolled airflows often increase building energy use; for example, leaky ducts located on a rooftop may draw in very hot air and leaky interior ducts can increase fan energy consumption. Thermal discomfort may result because uncontrolled airflows may prevent adequate space thermal conditioning. In hot humid climates, uncontrolled airflows increase the risk of high moisture levels or water vapor condensation in building envelopes, which in turn may cause microbiological contamination problems and related health effects. Research is needed to better understand the prevalences, nature, and effects of these uncontrolled airflows and also to develop remedial measures and stimulate their adoption. Research findings might justify an increased emphasis on prevention of uncontrolled airflow in future versions of ASHRAE's standards.

- **Health, comfort, and productivity impacts of fixed and operable windows.**

Buildings that are naturally ventilated with operable windows will often consume less energy than comparable sealed air-conditioned buildings located in the same climate. Increased use of operable windows may be an attractive energy efficiency measure in appropriate climates. Operable windows have a range of effects on indoor air pollutants, noise levels, thermal conditions, and on occupants' perceptions and satisfaction. Research is needed to better understand the health, comfort, productivity, and IAQ impacts of fixed and operable windows.

- **Ventilation and thermal insulation practices for attics and crawl spaces.**

Residences and small commercial buildings often have attics and crawlspaces. (In some small commercial buildings, thermal insulation is placed on the upper surface of the suspended ceiling, and the space above this insulation is ventilated like an attic.) The methods used to insulate and ventilate attics and crawlspaces, and the associated use of vapor barriers affect heating and cooling loads and can also affect indoor air quality. The location of thermal insulation is an important variable. In attics, insulation is traditionally placed immediately above the ceiling and the attic is ventilated; however, there is a growing interest in insulation installed on the underside of the roof of unventilated attics. There is also a growing interest in sealed crawlspaces insulated at the perimeter crawlspace walls. These insulation and ventilation options may affect the prevalence of both moisture problems and elevated radon concentrations. Research is needed to

better understand the energy and IAQ implications of these ventilation and thermal insulation practices for attics and crawlspaces.

Standards 62.1 and 62.2

The primary emphasis of Standards 62.1 and 62.2 is the selection of minimum ventilation rates for acceptable IAQ. Ventilation rate is only one of several factors strongly influencing IAQ and occupant health and productivity. The strong focus of Standards 62.1 and 62.2 on ventilation rates, and the corresponding focus of the ASHRAE membership on ventilation, is consistent with ASHRAE's mission. However, a balanced and optimal approach to IAQ control must also emphasize indoor pollutant sources and the other factors that affect IAQ. Accordingly, the EHC Research Subcommittee believes that there is a need to develop more general standards, guidelines, or best practices for maintaining the health and productivity of building occupants. While ASHRAE may not be the appropriate organization to lead the development of these more general standards and guidelines, there is clearly a role for ASHRAE should such an effort be initiated by another organization.

Standards 62.1 and 62.2 must consider IAQ and health when selecting minimum recommended ventilation rates, and also for other elements of these standards. In addition to the set of research needs provided by SPC 62.1 (attached to this memorandum), the EHC Research Subcommittee identified the following more general areas of research needs applicable to both Standards 62.1 and 62.2.

- **Relationship of building ventilation rates with human outcomes.** The only substantial body of high-quality data relating ventilation rates and human outcomes, i.e., health (symptoms, respiratory illness), perceptions (e.g., satisfaction with IAQ), and productivity, are from studies in office buildings located in cold or moderate climates. Studies are needed for other types of buildings such as schools, retail buildings, and residences and for buildings in hot-humid climates. Also, the benefits of increasing ventilation rates above 20 cfm (10 L s^{-1}) per person has been inadequately studied for all building types and climates.
- **Indoor pollutant concentration guidelines applicable for non-industrial indoor spaces.** Research is needed to develop more guidelines for indoor pollutant concentrations in non-industrial indoor spaces. These guidelines should reflect the types of people and mixtures of pollutants present within these spaces, which differ from the people and pollutants in industrial settings. This research would facilitate use of the IAQ procedure in Standard 62.1.
- **Practical means of maintaining indoor pollutant concentrations.** Research is needed to develop or evaluate practical means of maintaining indoor pollutant concentrations below guideline values, considering the design as well as practices of construction, operation, and maintenance for HVAC systems and entire

buildings. This research should include evaluations of potential alternatives to high ventilation rates including pollutant source control measures and air cleaning.

- **Recommended indoor humidities.** Research is needed to increase our knowledge of the appropriate indoor humidity range for limiting indoor microbiological contamination and associated health effects.

Standard 161P

The EHC Research Subcommittee reviewed research recommendations in the recent report by the National Academy of Sciences entitled "The Airliner Cabin Environment and the Health of Passengers and Crew". Each of the research recommendations in this report is summarized below. Each recommendation is relevant to Standard 161P.

- **Ozone in aircraft** Research is needed to advance our understanding of the dependence of aircraft cabin ozone concentrations on ozone converter performance, nature of aircraft surfaces contacting the indoor air, and on outdoor ozone concentrations. Research is also needed on the health effects of ozone exposures in aircraft.
- **Cabin pressure** Research is needed to improve our understanding of the effects of cabin pressure, and associated oxygen partial pressure, on health.
- **Outside air ventilation rates.** Research is needed to better characterize the relationship of outside air ventilation rates in aircraft with health complaints and with rates of infectious disease transmission.
- **Air quality incidents** Research is needed to characterize the nature, concentrations, and toxicity of pollutants in aircraft cabins as a consequence of incidents or equipment failures in aircraft. These pollutants may include thermal degradation products of engine oils, hydraulic fluids, and deicing fluids.
- **Pesticides** The exposures to pesticides in aircraft and associated health effects should be studied.
- **Low relative humidities.** Research is needed to characterize the effects of low relative humidities in aircraft on irritation symptoms and sensations of dryness.